

List of Claims

1. - 10. (cancelled)

11. (currently amended) A method of operating a fuel injector, comprising the steps of:

raising fuel pressure in a nozzle chamber at least in part by energizing a first electrical actuator;

opening a single nozzle outlet set of the fuel injector for each of a first injection event, a second injection event and a third injection event respectively at a selected timing at least in part by positioning a needle control valve at a first position that fluidly connects a needle control chamber to a low pressure passage;

closing the single nozzle outlet set at a selected timing after the opening step for at the first injection event including de-energizing the first electrical actuator to move a pressure control valve to a first position that opens the nozzle chamber to a spill passage while maintaining the needle control valve in the first position;

closing the single nozzle outlet set at a selected timing after the opening step for at the second injection event including equalizing opening and closing hydraulic pressure forces on a needle valve member to move the needle valve member toward a closed position with a spring force by moving the needle control valve to a second position that fluidly closes the needle control chamber to the low pressure passage before de-energizing the first electrical actuator;

closing the single nozzle outlet set at a selected timing after the opening step for at the third injection event including equalizing opening and closing hydraulic pressure forces on a needle valve member to move the needle valve member toward the closed position with the spring force by moving the needle control valve to the second position after de-energizing the first electrical actuator.

12. (previously presented) The method of claim 11 wherein the opening a single nozzle outlet set step includes a step that is one of:

energizing and de-energizing a second electrical actuator to move the needle control valve from a second position to the first position.

13. (original) The method of claim 11 wherein the needle control valve is positioned in the first position before the step of energizing the first electrical actuator.

14. (previously presented) The method of claim 11 wherein the opening a single nozzle outlet set step is performed at a selected valve opening pressure at least in part by one of energizing and de-energizing a second electrical actuator to move the needle control valve from the second position to the first position a predetermined timing after the step of energizing the first electrical actuator.

15. (previously presented) The method of claim 11 including a step of producing a split injection at least in part by moving the needle control valve from the first position to the second position and then back to the first position while the first electrical actuator remains energized before performing the closing step for one of the first injection event, the second injection event and third injection event.

16. (original) The method of claim 11 wherein the step of closing the single nozzle outlet set is performed at a selected valve closing pressure at least in part by moving the needle control valve from the second position to the first position at a predetermined timing relative to de-energizing the first electrical actuator.

17. (withdrawn) The method of claim 11 including a step of maintaining a unobstructed fluid connection between the needle control chamber and the nozzle chamber via an A orifice.

18. (withdrawn) The method of claim 17 wherein the step of opening a single nozzle outlet set includes a step of fluidly connecting the needle control chamber to a low pressure passage via a Z orifice having a larger flow area than the A orifice.

19. (original) The method of claim 11 wherein the raising fuel pressure step includes a step of moving a plunger into a fuel pressurization chamber within the fuel injector.

20. (original) The method of claim 19 wherein the step of moving a plunger is accomplished at least in part by moving a tappet into the fuel injector.